5.1. McMurdo Station (04/01/09 – 02/15/10)

The 2009/10 season at McMurdo Station is from 04/01/09 to 02/15/10. Measurements were affected by problems with the system's "Spectralink I/O card," which interfaces the system with the control computer. Due to intermittent data transfers by this module, many solar scans were lost, and successful absolute scans could not be performed between 5/6/09 and 2/9/10. Changes in the SUV-100 responsivity during this period were estimated by comparing SUV-100 measurements with (1) data of the collocated GUV-511 radiometer and (2) results of radiative transfer model calculations. These comparisons indicated that the SUV-100 responsivity was stable between the beginning of the reporting period and the end of October 2009. Thereafter, small drifts (<6.5%) in the SUV dataset were observed.

Calibrations for November and December 2009 are based on absolute scans performed in April and May 2009, scaled upward by factors ranging between 1.015 and 1.045. The calibration applied to solar data of 2010 are based on one absolute scan, which was performed on 2/9/10. The published dataset, with these scaled-up calibrations applied, does not show any obvious drift with the respect to the GUV data or the model. Final data review indicated that the uncertainty of published solar data is only slightly (1%) larger than usual.

The most significant gaps in solar data due to the Spectralink problem occurred during the periods 8/27/09 – 9/4/09, 9/19/09 – 9/23/09, 10/2/09 – 10/5/09, 10/20/09 – 10/21/09, 11/04/09 – 11/05/09, 12/19/09 – 1/12/10, 1/16/09 – 1/20/10, and 1/23/09 – 1/24/10. There are no SUV-100 data after 2/15/10. The Spectralink I/O card was replaced in August 2010 and the system is fully functional as of this writing.

5.1.1. Irradiance Calibration

The site irradiance standards for the McMurdo 2009/10 season were the lamps M-543, 200W005, 200W011, and 200W019. Lamps 200W017 and 200W041 were used as traveling standard in 2009. There were no lamp comparisons in 2010.

On-site standards

Lamps M-543, 200W005, and 200W019 have been in service for a long time and have been recalibrated several times since their first use. The three lamps were last re-calibrated against the traveling standard M-763 using "closing" scans from the 2008 site visit. This calibration was used for processing solar data of Volumes 17-19. More details of the lamps' history and the latest recalibration procedure can be found in the Volume 17 Operations Report. Lamp 200W011 was put into service in January 2008 and also calibrated against the traveling standard M-763. It serves as a long-term standard for McMurdo.

Traveling standards

Lamp 200W017 has been originally calibrated by Optronic Laboratories in March 2001. It has been recalibrated in June 2007 at BSI against a set of four 1000-W FEL lamps, which in turn had been calibrated by the U.S. Central UV Calibration Facility (CUCF) in Boulder, Colo. This calibration procedure was complicated by the fact that the irradiance scale of the four FEL lamps refers to the detector-based scale of the National Institute of Standards and Technology established in 2000 (NIST2000; Yoon et al., 2002), whereas all solar data of the NSF UVSIMN refer to the source-based NIST scale from 1990 (NIST1990, Walker et al., 1987). The NIST2000 scale is about 1.3% larger than the NIST1990 scale. Data of certificates issued by the CUCF were converted to the NIST1990 scale before the calibration was transferred to 200W017. Lamp 200W041 was calibrated in June 2007 in the same way as lamp 200W017.

Figure 5.1.1 shows a comparison of the three site standards against traveling standard 200W017 based on data collected on 2/11/09. There is excellent agreement between the datasets of lamps M-543 and 200W019, but both datasets are about 1.5% low compared to the data of the traveling standard 200W017. Measurements of the two travelling standards 200W017 and 200W041 differ by 1.5% in the UV and 0-1%

in the visible. A difference of 1.5% is well within the uncertainty of the traveling standard's calibration. The large difference of 3.5% between lamps 200W005 and 200W017 is surprising as tests of 200W005 agreed to within ±1% with measurements of lamps M-543, 200W019 on 4/23/08, 8/27/08, 11/20/08, and 5/5/09 (Figure 5.1.2). Measurement of lamps 200W011 on 5/5/09 also agreed to within ±1.5% with the other three lamps. These comparisons suggest that the irradiance scale applied to solar data of the 2009/2010 season at McMurdo is accurate to within ±1.5% .

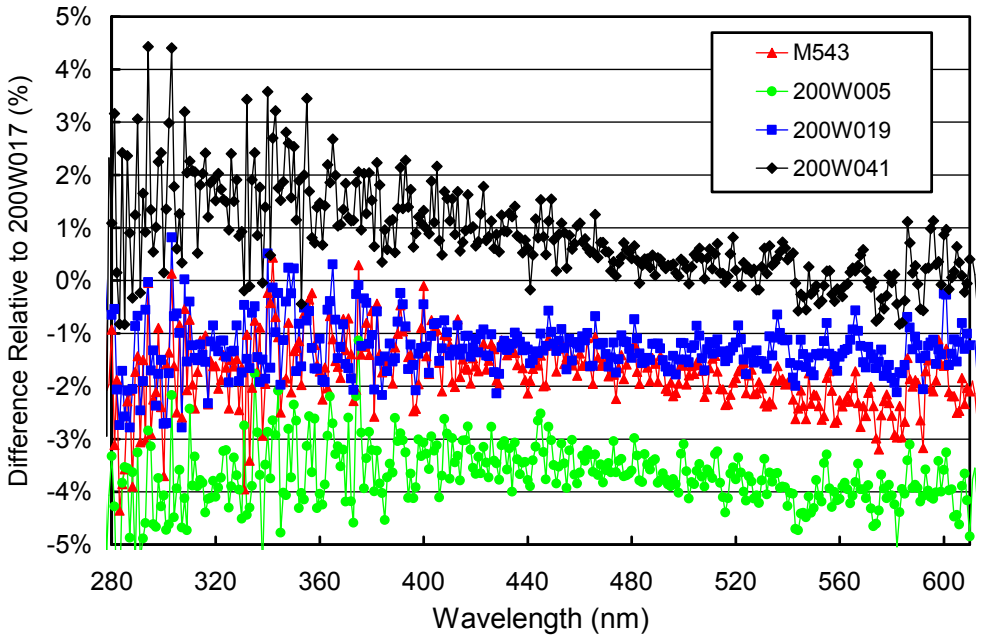

Figure 5.1.1. *Comparison of McMurdo lamps M-543, 200W005, 200W019 and 200W041 with the BSI traveling standard 200W017 on 2/11/09.*

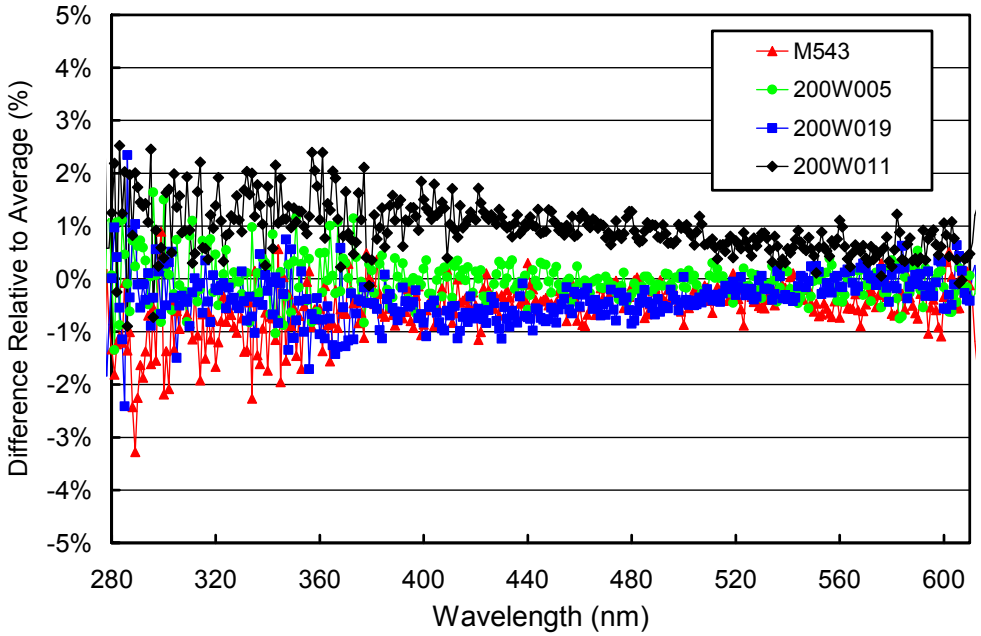

Figure 5.1.2. *Comparison of McMurdo lamps M-543, 200W005, and 200W019 and 200W011 on 5/5/09.*

5.1.2. Instrument Stability

The stability of the spectroradiometer over time was assessed by comparison with data of the collocated GUV-511 radiometer and model calculations that are part of "Version 2" data processing. Figure 5.1.3 shows the ratio of GUV-511 (340 nm channel) and final SUV-100 measurements, which were weighted with the spectral response function of this channel. The ratio is normalized and should ideally be one. The graph indicates that GUV and SUV measurements are consistent to within ±4%. There is no clear trend over time, indicating that drifts in SUV measurements were adequately corrected by adjusting the system's calibration. Times when the calibration changed are indicated by vertical lines. Five calibrations were applied (P1 – P5). More information on these calibrations is provided in Table 5.1.1. Figure 5.1.4 shows ratios of the calibration functions applied during Periods P2 – P5, relative to the function of Period P1. The change over the course of the season is generally smaller than 6.5% at all wavelengths.

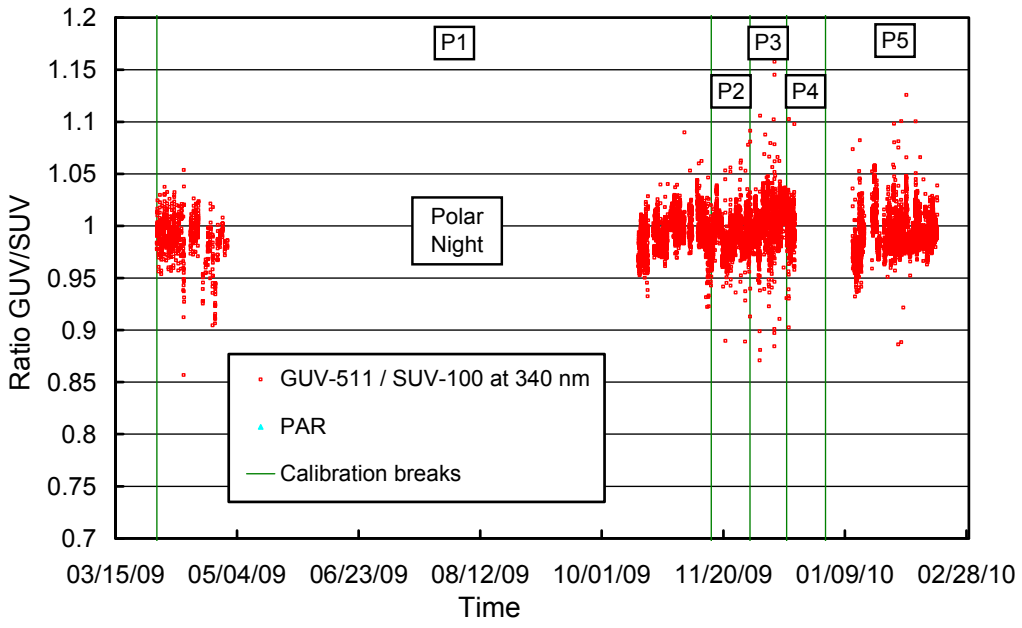

Figure 5.1.3. *Ratio of GUV-511 measurements of its 340 nm channel with final SUV-100 measurements that were weighted with the spectral response function of this channel.*

Table 5.1.1: Calibration periods for McMurdo Volume 19 data.

Period name	Period range	Number of Absolute Scans	Remarks
P1	04/01/09 - 11/14/09	5	1 scan from 3/13/10; 4 scans from 05/05/10
P2	11/15/09 - 11/30/09	0	P1, scaled up by 1.5%
P3	12/01/09 - 12/15/09	0	P1, scaled up by 3.0%
P4	12/16/09 - 12/31/09	0	P1, scaled up by 4.5%
P5	01/01/10 - 02/28/10	1	1 scan performed on 02/09/10

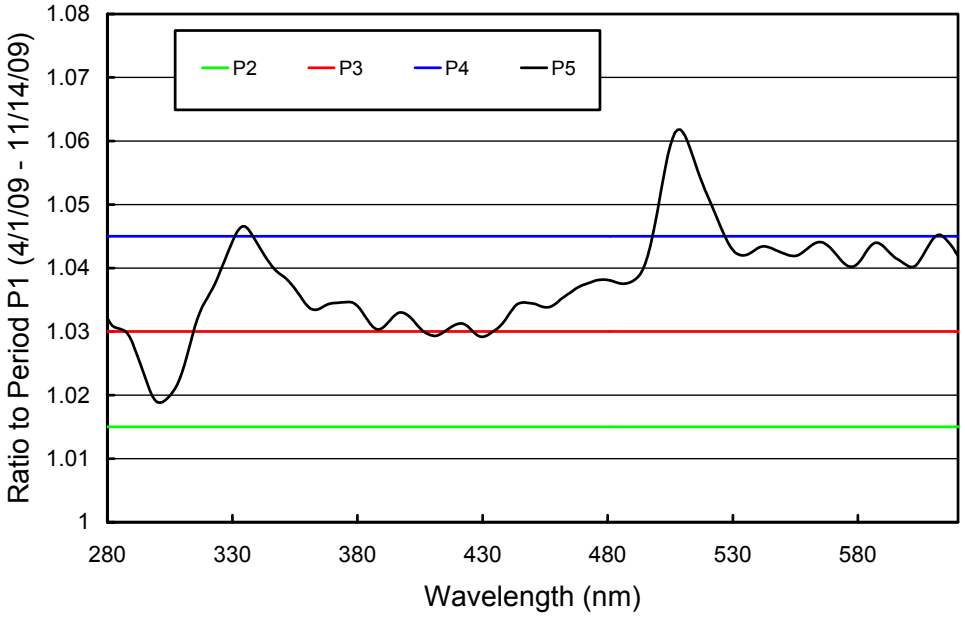

Figure 5.1.4 *Ratios of irradiance assigned to the internal reference lamp during periods P2 – P5, relative to Period P1.*

5.1.3. Wavelength Calibration

Wavelength stability of the system was monitored with the internal mercury lamp. Information from the daily wavelength scans was used to homogenize the data set by correcting day-to-day fluctuations in the wavelength offset. The wavelength-dependent bias of this homogenized dataset and the correct wavelength scale was determined with the Version 2 Fraunhofer-line correlation method (Bernhard et al., 2004). Figure 5.1.5 shows the correction function calculated with this algorithm. Figure 5.1.6 indicates the wavelength accuracy of final Version 0 data for five wavelengths in the UV and visible by running the Version 2 Fraunhofer-line correlation method a second time. Shifts are typically smaller than ±0.05 nm. Version 2 data have even smaller wavelength errors.

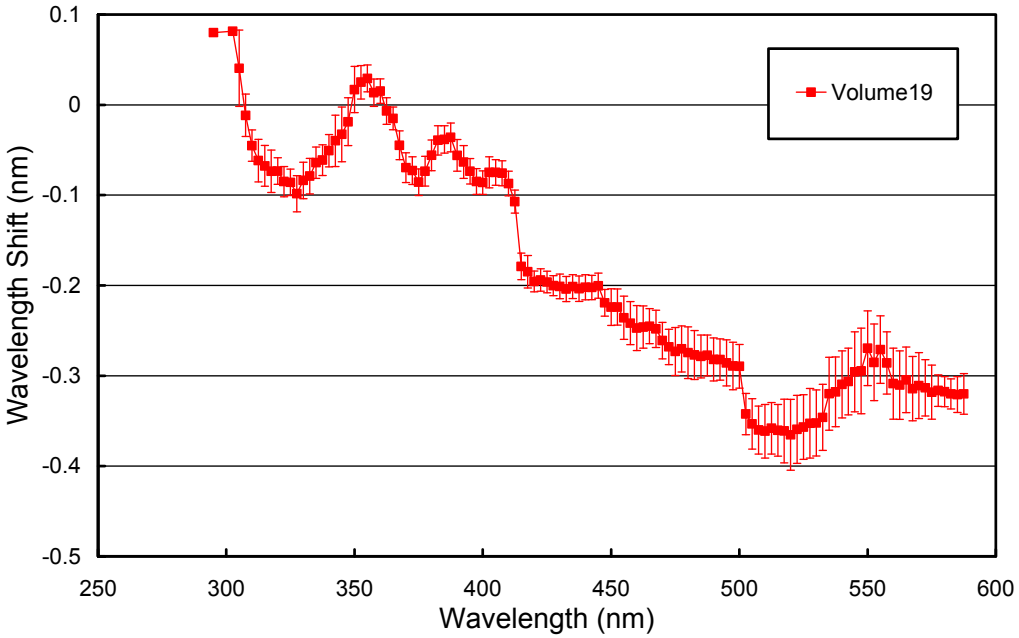

Figure 5.1.5. *Monochromator non-linearity correction function. Error bars indicate the 1σ-variation.*

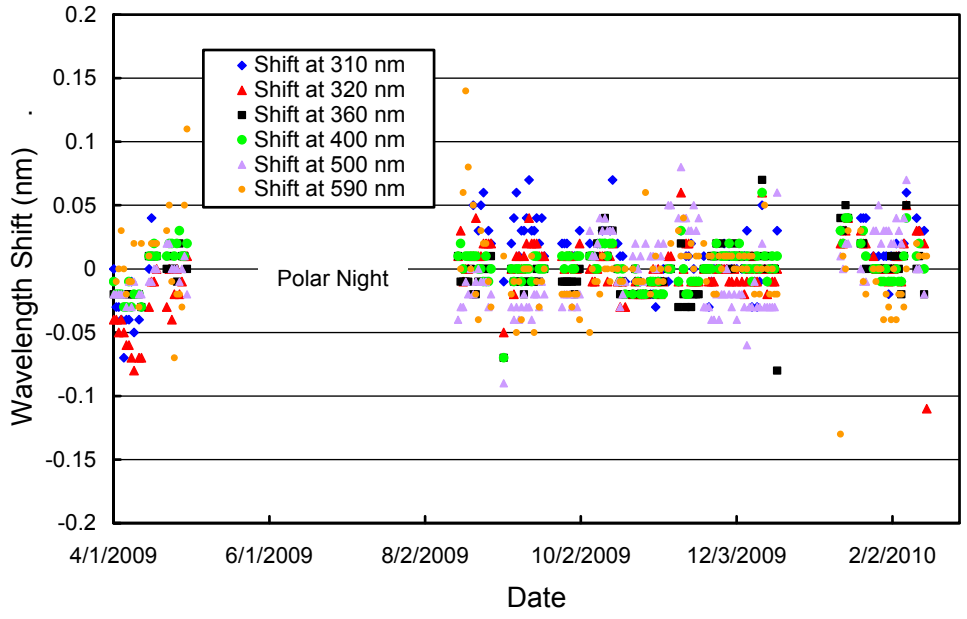

Figure 5.1.6. *Check of the wavelength accuracy of final data at four wavelengths by means of Fraunhofer-line correlation. The noontime measurement has been evaluated for each day of the season. No correlation data is available during Polar Night. No data are available between 12/19/10 and 1/12/10.*